TURFGRASS

&

LANDSCAPE MANAGEMENT

FIELD DAY

September 24, 2002

University of California, Riverside
Cooperative Extension
Dept. of Botany and Plant Sciences
Agricultural Operations

TURFGRASS AND LANDSCAPE MANAGEMENT FIELD DAY
TUESDAY, SEPTEMBER 24, 2002

TABLE OF CONTENTS AND FIELD DAY SCHEDULE

This material is based upon work supported by the Cooperative State Research, Education and Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.

The Development of the University of California, Riverside Plots is Largely Due to the Generosity of the Firms and Organizations Shown Here

INLAND EMPIRE COMPOSTING
CALIFORNIA SOD PRODUCERS ASSOCIATION
California GCSA
PGA
WESTERN FARM SERVICE
Quality Turf
WEST COAST TURF
ANR
Hunter
HI-LO DESERT GOLF COURSE SUPERINTENDENTS ASSOC.
STOVER SEED COMPANY
WESTERN TURF JACOBSEN TEXTRON
NTEP
OMC Lincoln
SAN DIEGO GOLF COURSE SUPERINTENDENTS ASSOC.
IRROMETER
CALIFORNIA TURF
TORO
MWD
A-6 Sod Farms Inc.
SEEDS WEST INC.
Southern California Turfgrass Foundation
Rogers Innovative Inc.
THE USGA
SOUTHERN CALIFORNIA GOLF ASSOCIATION
Golf Course Superintendents Association Southern California
BARENBRUG
BARENBRUG USA
TRI-Pro
GOLF COURSE SUPERINTENDENTS ASSOCIATION OF AMERICA
The Southern California TURFGRASS COUNCIL
GERMAIN'S SEEDS
SOUTHLAND SOD FARMS
California Bio-Mass, Inc.
RAIN BIRD

http://ucrturf.ucr.edu -- Meaty Website Launched by UCR Turfgrass Research Program

Coinciding with the Turfgrass and Landscape Management Field Day on Sept. 24, 2002, the University of California, Riverside (UCR) Turfgrass Research Program unveiled its new website: -- **http://ucrturf.ucr.edu –** which is loaded with meaty information organized into a number of categories:

- **UCR TURF Home Page**
- **General Information**
- **Research Projects**
- **Reports on Topical Issues**
- **Research Conference and Field Day**
- **UCRTRAC (UCR Turfgrass Research Advisory Committee)**
- **Publications**
- **Turf Links**
- **Search**

"We have designed the UCR Turf website as a multi-linked, user-friendly communication vehicle that provides a clearinghouse of pertinent, accurate information for the turfgrass industry, university researchers, government agencies, and the general public interested in turf issues, such as water conservation and quality," said **Robert Green**, UCR Turfgrass Research Agronomist.

UCR TURF Home Page. This section provides turfgrass management information for homeowners, including links to several UC websites, publications, and programs that offer lawn care information, such as the website of the California Master Gardener Program, a statewide volunteer program of UC Cooperative Extension whereby the UC extends research-based information in home horticulture and pest management, verified by UC experts, to Californians. The home page also offers links to educational programs, seminars, and workshops for those interested in obtaining turfgrass-related college degrees, certificates, and continuing education credits (CECs).

General Information. This section provides general information about the UCR Turfgrass Research Program, including facilities, research focus, and outreach activities.

Research Projects. Five categories of ongoing and recently completed research projects are featured in this section of the website:

(1) Water Use Efficiency
(2) New Turfgrass Development and Establishment
(3) Chemical and Fertilizer Environmental Impacts
(4) Unbiased Product Testing
(5) Sports Turf Management

Thumbnails and more complete summaries of research results are provided.

Reports on Topical Issues. The website currently includes reports about TMDLs (total maximum daily loads) and Clean Water Act enforcement, turfgrass fertilization, and trends in the turfgrass industries. Many more reports will be added.

Research Conference and Field Day. This portion of the website provides timely information about this annual event sponsored by the UCR Turfgrass Research Program.

UCRTRAC. The UCR Turfgrass Research Advisory Committee (UCRTRAC), consisting of UCR and 10 turf industry partners (golf, sod, and general turf interests), was established in 1996 to form an industry-wide linkage between UCR and the turfgrass industries in Southern California. The UCRTRAC Annual Research Summary Reports and periodic newsletter, ***Better Turf Thru Agronomics***, are on the website. A ***cumulative index*** of newsletter articles from 1996 to the present, keyed to the 11 areas of research and education needs identified by UCRTRAC delegates, facilitates searching for articles of interest.

Links to the websites of each UCRTRAC member organization (Southern California Golf Association, California Golf Course Superintendents Association [GCSA], San Diego GCSA, Hi-Lo Desert GCSA, CGSA of Southern California, California Sod Producers Association, Southern California Section, Professional Golfers Association, Southern California Turfgrass Council, Southern California Turfgrass Foundation, United States Golf Association, and UCR) are provided in this section of the UCR Turf website.

Publications. Links are available to publications associated with the UCR Turfgrass Research Program, including ***Better Turf Thru Agronomics***, ***California Turfgrass Culture,*** and ***Proceedings of the UCR Turfgrass and Landscape Research Conference and Field Day*** (1995-present).

Turf Links. Important legislation, memoranda, and statistics that impact the turfgrass industries in Southern California are available on the UCR Turf website via its links. Water-related websites are featured. Multiple links to the websites of California state government agencies, turfgrass industry associations, and university research centers are offered. Included are pertinent UC systemwide Agriculture and Natural Resources websites, UCR websites, and websites of other university-based turfgrass research and education programs in the United States and Canada. Links to the websites of professional societies, associations, and organizations based in California, nationwide, and internationally are also here. Links to educational and other resources, such as CIMIS (California Irrigation Management and Information System), are also provided.

Search. A search of the entire UCR Turf website, powered by Google, is available.

UCR Staff Research Associate **Grant Klein** is the UCR Turf webmaster. The website is overseen by **Robert Green**, UCR Turfgrass Research Agronomist, and **Vic Gibeault**, Extension Environmental Horticulturist.

Prepared by Deborah Silva, Science Writer and Editor

FIELD DAY ABSTRACTS

GREEN WASTE COMPOST AS A TURF SOIL AMENDMENT

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Turfgrass areas are anticipated to become a larger recipient of green waste compost diverted from landfills. Amending the soil with the material is one method that can utilize compost and potentially benefit turfgrass. However, the optimum level of amendment is not known for the beneficial effects of amending with compost. The objective of this study is to bracket the optimum beneficial amendment volume for growing bermudagrass, and using it as a sports field, in a sandy loam soil.

This data represents 2 years of a 3-year study. Composted green waste was incorporated into the top 4 inches of the soil in early August 2000 at 3 rates (4, 8, and 12 yd^3 per 1000 ft^2). An unamended control was included. Arizona common bermudagrass was seeded 2 weeks later. Simulated sports traffic was begun in May 2001 and applies 3 passes every 2 weeks. Irrigation is applied at about 80% of historic reference ET. Run time adjustments are made at least monthly. Fertilizer is applied every 6 weeks during the growing season for a total of 5 lbs. N per 1000 ft^2 per year.

Turf visual quality, surface hardness, plant mass, water infiltration rate and surface elevations are measured regularly. Quality is assessed using a 1-9 scale, hardness is measured with a Clegg Impact Tester, infiltration is quantified using an infiltrometer in two locations per plot, and oven-dried plant mass is measured after removing soil from a 2 inch diameter by 4 inch deep soil core and separating into shoots and roots. Experiment design is a randomized complete block with 6 replicates in two plots.

12 yd^3	12 yd^3	4 yd^3	4 yd^3	12 yd^3	12 yd^3
none	none	12 yd^3	12 yd^3	4 yd^3	4 yd^3
4 yd^3	4 yd^3	8 yd^3	8 yd^3	8 yd^3	8 yd^3
8 yd^3	8 yd^3	none	none	none	none

12 yd^3	12 yd^3	none	none	4 yd^3	4 yd^3
none	none	8 yd^3	8 yd^3	12 yd^3	12 yd^3
4 yd^3	4 yd^3	4 yd^3	4 yd^3	8 yd^3	8 yd^3
8 yd^3	8 yd^3	12 yd^3	12 yd^3	none	none

traffic (pink cells: columns 2, 3 and 6 of the top plot; columns 2, 3 and 6 of the bottom plot)

no traffic

2[nd] year results

Amending soil does affect several qualities of bermudagrass turf and soil after 2 years.

- *The field surface is softer with amendments.*

As composted green waste amendments are increased, the surface is softer, although there is no difference between 8 and 12 yd^3 amendment per 1000 ft^2. There is a slight increase in hardness with traffic among each treatment.

- *Infiltration rate is improved with amendments.*

The more amendment added tended to produce faster infiltration. 12 yd^3 per 1000 ft^2 produced greater rates than 8 yd^3 but 8 yd^3 was similar to 4 yd^3 and the control. Treatments without traffic had almost 4 times faster rates than treatments with traffic.

- *Amending soil increases plant mass.*

Amending the soil increased total plant mass but the effect wasn't significant until 12 yd^3 had been incorporated. There was more turf root mass with 12 and 8 yd^3 when compared with the no amendment treatment and slightly more with 4 yd^3 amendment rate. Traffic did not affect total mass.

- *Turf quality is unaffected by amendment amount during the growing season.*

From May to October there were no significant turf quality differences among amendment treatments. Traffic produced lower quality from December through March.

Funding for this study has come from the University of California Division of Agricultural and Natural Resources and support has been provided by *California Biomass*, *Inland Composting and Organic Recycling*, and UCR Agricultural Operations.

LANDSCAPE-APPLIED PESTICIDES' IMPACT ON URBAN WATER QUALITY

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Proper pest and weed management are important to maintain the health and aesthetics of home lawns and gardens. However, pesticides used in residential landscapes may move in runoff to urban streams and impact urban water quality. Surveys have shown that 99% of urban streams contain at least one pesticide, and 70% of urban streams are contaminated with 5 or more pesticides. Pesticide use in residential landscapes is the single most important contributor to pesticides in urban streams. Pesticides in urban streams may cause short or long-term effects to aquatic ecosystems. Strict regulations and water quality standards are being enforced to protect urban water quality, and mitigation of pesticide contamination from residential landscapes is of great urgency and importance.

Understanding Causes:

Three players are involved in pesticide runoff: pesticides, landscape systems, and water. It is important to know that pesticides are very different creatures, and the worst kinds are those that are relatively soluble in water and do not degrade quickly in soil. Landscape plantings, depending on their types, may enhance or reduce pesticide runoff. The worst kinds are those that have exposed and/or impermeable surfaces. Pesticide runoff is driven by water flow and happens only after excessive irrigation or rainstorms.

Pesticide Selection:

Typically, multiple products are available for the same treatment, which makes selecting the right pesticides a good place to start. There are many places where you can find information on a pesticide's runoff potential, and a good one is the *PesticideWise* website at http://www.pw.ucr.edu/. At this website, you may enter several pesticides and compare their ability for runoff. The rule of thumb is to stay away from persistent and soluble products.

Landscape Plants and Slope:

It is important to realize that most residential landscapes have mixed planting systems. In terms of pesticide runoff, the following order applies: pavement (driveways, sidewalks) > exposed soil surfaces > shrubs, trees > ground covers > grass, mulches. Another important factor is slope, because steep slopes cause active surface runoff or erosion.

Water Management:

Pesticide runoff only happens when there is active over-land water flow. Storm water runoff and excessive irrigation are always the major reasons for pesticide contamination of urban streams. In California, rainstorms typically happen only in the winter months.

Options, options, options . . .

- Do not allow pesticides to drift to paved areas.
- Do not apply pesticides on exposed soil surfaces.
- Use less pesticide or perform spot treatments in sloped areas.
- Do not irrigate excessively following pesticide application.
- Avoid applying pesticides during winter months when rains are often.
- Use alternative practices and IPM whenever possible.

TRANSPLANTING PALMS: EFFECTS OF LEAF REMOVAL AND TIE-UP

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Palms are high-value components of the California landscape. Landscape contractors and nurserymen spend considerable resources and labor transplanting palms since removal of some of the leaves and tying up the remaining ones during the transplant operation are standard industry practices. These two practices detract from the ornamental and esthetic value of the newly transplanted palms but are purported to reduce water loss, thus improving reestablishment. Are these common practices really beneficial when transplanting palms? Do they improve and hasten reestablishment? There is no research-based information on the effects leaf removal or tie up when transplanting palms in California. Thus, the benefits of either practice are undocumented.

Methods

In August 2001, we removed 30, 15-gallon plants each of *Phoenix canariensis* (Canary Island date palm) and *Syagrus romanzoffiana* (queen palm) from their containers and clipped back the root balls to 3 inches (7.5 cm) from the center of the stem at its base, resulting in a cylindrical root ball 6 inches (15 cm) in diameter and 12 to 15 inches (30 to 38 cm) long or deep. We estimated that 60 to 70 percent of the roots were removed. The procedure was designed to simulate transplanting mature palms where typically well over half the roots are removed. We immediately repotted each palm and subjected them to one of these five treatments:

1. complete leaf removal
2. no leaf removal, no tie up (check)
3. no leaf removal, tie up
4. remove half of leaves, tie up
5. remove half of leaves, no tie up

The treatments for each species were replicated 6 times and the palms were arranged in a randomized complete block design (5 treatments x 6 replications x 2 species = 60 palms total).

Leaf transpiration and internal leaf water potential (an estimate of relative water stress) of each palm were measured using a steady-state porometer and pressure chamber, respectively. Transpiration readings were recorded immediately after treatments were imposed and at 1, 4, 8, 12, and 25 weeks after treatment. Leaf water potential readings were recorded at 1, 2, 4, 8, 12, and 25 weeks after treatment.

By late February 2002, roots were emerging from the bottom of the containers. On March 1, 2002, we removed the palms from their containers, recorded the number of new leaves produced since the start of the trial, and clipped back the root balls to the same size that we had at the start of the project. The new leaves were counted and recorded. The new leaves and roots were dried and their weight (mass) recorded.

Preliminary Results

None of the treatments affected survival. All 60 palms survived and grew enough new leaves and roots to establish successfully. We also observed in both species that many of the severed roots resprouted just behind the cut.

For *Syagrus*, the treatments had no effect on the number and mass of new leaves produced. The effect of treatments on mass of new roots produced was less clear. The two leaf-tie-up treatments produced the greatest mass of new roots and were significantly better than the complete-leaf-removal treatment. The two no-leaf-tie-up treatments were intermediate and were not significantly different from the two leaf-tie-up or complete leaf removal treatments.

For *Phoenix*, the number of new leaves produced was unaffected by the treatments. Complete leaf removal produced significantly less leaf mass than all other treatments. The check (no leaf removal, no leaf tie up) produced the greatest mass of new leaves and was significantly better than the no-leaf-removal, leaf-tie-up and complete-leaf-removal treatments. The two treatments removing half the leaves were somewhat intermediate and were not significantly different from the two no-leaf-removal treatments. The two no-leaf-tie-up treatments produced significantly greater root mass than all the other treatments.

For both palm species there was no effect on leaf transpiration rates immediately after the treatments were imposed. At one week after treatment, however, transpiration was lowest in the two no-leaf-removal treatments. Over the entire study period, though, transpiration was lowest on the two no-leaf-tie-up treatments and highest on the treatment removing half the leaves and tying up the remaining ones. Transpiration was intermediate on the no-leaf-removal and tie-up treatment.

Water stress levels of *Phoenix* were unaffected by treatments until 12 weeks after the treatments were imposed. From that time until the end of the study, water stress was greater in the two leaf-tie-up and in the complete-leaf-removal treatments. *Syagrus* did not show differences in water stress until 25 weeks after the treatments, at which time stress levels were greatest in the complete-leaf-removal and in the no-leaf-removal treatments. However, over the entire study period water stress for both species was unaffected by any treatment.

NEW FUNGICIDES FOR CALIFORNIA TURFGRASS 2002-2003

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There are a number of new fungicides that are will be or are currently being registered for use in California to control diseases on turfgrass. Listed below are six promising fungicides that have been or will be evaluated in this year's fungicide evaluation program at UC Riverside.

Chipco Triton 1.67 SC (*triticonazole*, Bayer). Triton is a new SI (sterol-biosynthesis inhibiting)-fungicide for use on turf. It is classified as an acropetal penetrant and will have a broad label against a number of turfgrass diseases including (but not limited to): anthracnose, brown patch, dollar spot, grey snow mold, leaf spot, pink snow mold, powdery mildew, rust, red thread, spring dead spot and take-all patch. Use rates will be 0.75 to 2.0 fl. oz./1000 ft^2. Registration is expected in expected late-2003 or early-2004.

Banol (*propamocarb*, Bayer). Banol has been registered for a number of years in many states, and a California registration is expected for 2003. It is a pythium-specific fungicide with a unique mode of action and acropetal penetrant systemicity. Use rates will be 1.3 to 4.0 fl. oz./1000 ft^2.

Emerald 70WG (BAS 510 F common name not yet approved, BASF). A reduced-risk fungicide developed specifically for the control of dollar spot on turf (*Sclerotinia homoeocarpa*). The fungicide belongs to the carboxanilide class of fungicides. The fungicide has good movement properties and is an acropetal penetrant. Use rates will be approximately 0.13 to 0.18 oz./1000 ft^2. Registration is expected in 2003.

Honor 50WG (BAS 505 F, *dimoxystrobin*, BASF). This is a new fungicide in the strobilurin (or QoI) – class of fungicides. It shows activity against anthracnose, bentgrass deadspot, brown patch, dollar spot, leaf spot, red thread, rust, summer patch and take-all patch. Use rate is expected to be 0.2 oz./1000 ft^2. The fungicide is in the process of registration, and is currently be evaluated in a number of University trials.

Insignia 20WG (*pyraclostrobin*, BASF). This is a new fungicide in the strobilurin (or QoI) – class of fungicides. It will be labeled against anthracnose, brown patch, bentgrass dead spot, fairy ring, fusarium patch, grey leaf spot, grey snow mold, leaf spot, pink patch, pink snow mold, powdery mildew, pythium blight, red thread, rust, summer patch, take-all patch, and a few other diseases. It is a localized penetrant fungicide, and use rates will be 0.5 to 0.9 oz./1000 ft^2. Registration is expected late-2002 or early-2003.

Medallion (*fludioxonil*, Syngenta). This fungicide belongs to the phenylpyrrole class of chemistry. The fungicide is a contact material only. It is labeled against bentgrass dead spot, brown and yellow patch, leaf spot, summer patch, and pink and grey snow molds. Use rates will be 0.25 to 0.5 oz./1000 ft^2. California registration will be in 2002.

EVALUATION OF FUNGICIDES FOR THE CONTROL OF DOLLAR SPOT IN SOUTHERN CALIFORNIA, 2002

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Host: CREEPING BENTGRASS (*Agrostis palustris* 'Brighton, SR 1120')
Pathogen: DOLLAR SPOT (*Sclerotinia homoeocarpa*)

The experiment was conducted on the campus of the University of California at Riverside at Agricultural Operations, located in Riverside, CA. Creeping bentgrass was established by seed on sand in 1999. The plot was mowed at a height of 0.25 inches, three days per week, with 5 lb N per 1000 ft^2 applied per year, distributed over 4 week intervals using a complete fertilizer. Irrigation was applied at ET_c with distribution of the irrigation system accounted for $((ET_o \times K_c)/D_u)$ where Kc is the crop coefficient (monthly). Fungicide applications were initiated on April 2, and plots were subsequently inoculated with *S. homeocarpa* – infested rye grain on April 1 at a rate of 1 lb./1000 ft^2 12 hours later. A pool of 6 isolates of *Sclerotinia homoeocarpa* were used to infest the rye grain. Subsequent fungicide applications were made at approximately 14, 21 or 28 day intervals after the first application. Treatments were applied with a CO_2-powered boom sprayer using Tee-jet 8002 nozzles at 40 psi, using the equivalent of 2 gallons of dilute fungicide solution per 1000 ft^2. Disease incidence was evaluated bi-weekly beginning on April 17. Data was analyzed by ANOVA and mean comparisons were performed using the Waller-Duncan k-ratio test ($\alpha = 0.05$).

			Application Date								Evaluation Date											
			April						May		17-Apr			30-Apr			14-May			28-May		
	Treatment	Rate oz./1000 sq. ft.	2-Apr		17-Apr		30-Apr		14-May		Infection Centers[a]	Relative Incidence[b]	Duncan-Waller Grouping[c]	Infection Centers[a]	Relative Incidence[b]	Duncan-Waller Grouping[c]	Infection Centers[a]	Relative Incidence[b]	Duncan-Waller Grouping[c]	Infection Centers[a]	Relative Incidence[b]	Duncan-Waller Grouping[c]
1	Daconil Ultrex 82.5 WG	3.2	x		x		x		x		1.3	7%	d	0.3	1%	g	0.0	0%	d	0.0	0%	f
2	Daconil Ultrex 82.5 WG	3.2	x			x			x		1.7	8%	d	0.0	0%	g	0.0	0%	d	0.0	0%	f
3	Daconil Ultrex 82.5 WG	3.2	x				x				1.7	8%	d	0.7	3%	g	0.0	0%	d	0.0	0%	f
4	BAS 510 02F	0.18	x		x		x		x		0.7	3%	d	1.0	4%	g	0.0	0%	d	0.0	0%	f
5	BAS 510 02F	0.18	x			x			x		1.7	8%	d	0.3	1%	g	0.0	0%	d	0.0	0%	f
6	BAS 510 02F	0.18	x				x				0.7	3%	d	0.7	3%	g	0.0	0%	d	0.0	0%	ef
7	BAS 505 03F	0.20	x		x		x		x		2.7	13%	cd	0.0	0%	g	0.3	2%	d	0.7	5%	f
8	BAS 505 03F	0.20	x			x			x		1.0	5%	d	1.0	4%	g	0.0	0%	d	0.0	0%	f
9	BAS 505 03F	0.20	x				x				1.0	5%	d	1.0	4%	g	0.0	0%	d	0.0	0%	f
10	Chipco Triton 1.67 SC	1.5	x		x		x		x		0.0	0%	d	0.0	0%	g	0.0	0%	d	0.0	0%	f
11	Chipco Triton 1.67 SC	1.5	x			x			x		2.7	13%	cd	0.7	3%	g	0.3	2%	d	0.0	0%	f
12	Chipco Triton 1.67 SC	1.5	x				x				1.0	5%	d	0.3	1%	g	0.0	0%	d	0.0	0%	f
13	Cleary's 3336F 50 WP	4.0	x		x		x		x		10.3	52%	b	16.0	64%	bc	7.3	34%	cd	4.3	31%	bcd
14	Cleary's 3336F 50 WP	4.0	x			x			x		13.7	68%	ab	13.0	52%	cd	6.0	28%	cd	3.7	26%	cde
15	Cleary's 3336F 50 WP	4.0	x				x				14.7	73%	ab	16.0	64%	bc	15.3	71%	ab	7.0	50%	b
16	Banner Maxx 1.3 MC	1.5	x		x		x		x		0.3	2%	d	1.0	4%	g	0.0	0%	d	0.0	0%	f
17	Banner Maxx 1.3 MC	1.5	x			x			x		0.3	2%	d	0.0	0%	g	0.0	0%	d	0.0	0%	f
18	Banner Maxx 1.3 MC	1.5	x				x				0.3	2%	d	0.3	1%	g	0.0	0%	d	0.0	0%	f
19	Chipco 26 GT 2.1 SC	4.0	x		x		x		x		0.0	0%	d	0.0	0%	g	0.0	0%	d	0.0	0%	f
20	Chipco 26 GT 2.1 SC	4.0	x			x			x		0.3	2%	d	0.0	0%	g	0.0	0%	d	0.0	0%	f
21	Chipco 26 GT 2.1 SC	4.0	x				x				1.3	7%	d	1.0	4%	g	0.0	0%	d	0.0	0%	f
22	710-140	25	x		x		x		x		16.0	80%	ab	18.7	75%	b	7.0	32%	cd	1.7	12%	edf
23	710-140	25	x				x				13.3	67%	ab	11.0	44%	cde	6.0	28%	cd	2.0	14%	edf
	Daconil Ultrex 82.5 WG	3.2			x				x													
24	Daconil Ultrex 82.5 WG	3.2	x		x		x		x		2.3	12%	d	2.3	9%	fg	0.0	0%	d	0.0	0%	f
	Cleary's 3336F 50 WP	4.0	x		x		x		x													
25	Daconil Ultrex 82.5 WG	3.2			x				x		15.3	77%	ab	9.3	37%	de	2.3	11%	cd	0.7	5%	ef
	Cleary's 3336F 50 WP	4.0	x				x															
26	Daconil Ultrex 82.5 WG	1.6	x		x		x		x		9.7	48%	b	7.3	29%	def	4.0	18%	cd	0.7	5%	ef
	Cleary's 3336F 50 WP	2.0	x		x		x		x													
27	Daconil Ultrex 82.5 WG	1.6			x				x		15.7	78%	ab	12.7	51%	cd	9.3	43%	bc	5.3	38%	bc
	Cleary's 3336F 50 WP	2.0	x				x															
28	Daconil Ultrex 82.5 WG	1.6	x		x		x		x		1.3	7%	d	0.7	3%	g	1.3	6%	cd	0.3	2%	ef
29	Daconil Ultrex 82.5 WG	1.6	x				x				0.3	2%	d	0.3	1%	g	0.0	0%	d	0.0	0%	f
30	Cleary's 3336F 50 WP	2.0	x		x		x		x		9.0	45%	bc	5.3	21%	efg	2.3	11%	cd	1.0	7%	ef
31	Cleary's 3336F 50 WP	2.0	x				x				10.0	50%	b	8.3	33%	de	6.3	29%	cd	2.3	17%	cdef
32	Untreated Check										20.0	100%	a	25.0	100%	a	21.7	100%	a	14.0	100%	a

Notes:

a = the average number of lesions for the replicated 3′ x 6′ plots
b = average disease expressed as a percentage of the non-treated check plots
c = treatments followed by different letters indicate significant differences between each treatment, based upon analysis of variance and Duncan-Waller groupings of significance with $\alpha = 0.05$.

Summary:

Based upon the inoculum load and prevailing environmental conditions, the infection pressure for the trial was light to moderate. An application of 1 lb./1000 ft^2. of nitrogen fertilizer (33-3-10) was made on April 25. This application in conjunction with the increase in air temperatures and decrease in relative humidity in late-April/early-May resulted in a gradual decline in disease and the recovery of the bentgrass to the damage inflicted by dollar spot.

The new fungicides BAS 510 F, BAS 505 F and Chipco Triton, as well as currently registered products (Banner Maxx, Chipco 26GT, and Daconil Ultrex) all provided high levels of control when applied prior to inoculation, on 14, 21 and 28 day schedules. The half rate of Daconil Ultrex (1.6 oz./1000 ft^2) also gave high levels of control on 14 and 28 day schedules. The biological-product 710-140 did not provided little control of the disease, but some control was evident when rotated with Daconil Ultrex at 3.2 oz/1000 ft^2. Cleary's 3336 F did not provide acceptable levels of control when applied alone at a rate of either 2.0 or 4.0 oz./1000 ft^2, indicating some level of benzimidazole-resistance in the population used to inoculate the plot. Alternation of Cleary's 3336 F with Daconil Ultrex (at both full- and half-rates) did not provide good control, although over the season, the overall control was better than Cleary's 3336 F alone. Half-rate mixtures of Cleary's 3336 F and Daconil Ultrex (2.0 and 1.6 oz./1000 ft^2, respectively) provided some control, but was inferior to the full rate mixtures (4.0 and 3.2 oz./1000 ft^2, respectively). Although this trial reflects a situation where benizimidazole resistance was present, this may not be the case for any given individual golf course. Regardless, both the data reflect the appropriateness of using full-rate mixtures or alternate fungicides for the control of such benzimidazole-resistant populations.

DEVELOPMENT OF NITROGEN BMPS FOR FERTILIZING LAWNS

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The definition of the phrase "best management practice" (BMP) varies depending on the specific context involved and the currently accepted standards and goals of agronomic management. In general, BMPs are considered to be a set of guidelines or procedures which have been determined, as part of an overall program, to be an effective and practical (technically, socially and economically) method for reducing, preventing, or controlling undesirable effects of management; promoting or maintaining beneficial effects of management; and/or protecting the environment or natural habitat. Turfgrass-related BMPs encompass a wide variety of activities, including fertilization, irrigation, mowing, pest control, and soil management. One of the most important set of turfgrass BMPs are those relating to providing adequate nitrogen (N) to provide the healthy, moderate (i.e., neither minimal or excessive) growth necessary to provide both acceptable visual appearance and the ability to cope with stresses such as drought, traffic, and disease.

Promoting moderate growth (and optimal uptake of N by the plant) is, in fact, one of the best defenses against N sources contaminating the environment. Nitrogen that isn't taken up by the plant is either stored in the soil or thatch, lost to the atmosphere [NH_3 volatilization and denitrification (the reduction of nitrates to gaseous nitrogen)], or lost to surface water in runoff or groundwater via leaching.

In the soil environment, the primary forms of N are organic N (the dominant form), ammonium-N (NH_4^+-N), nitrite-N (NO_2^--N), and nitrate-N (NO_3^--N). Unlike organic N and NH_4^+-N, nitrates do not bind to soils and thus have a high potential for leaching into groundwater. However, it should be noted that organic N and NH_4^+-N are potential nitrate sources, since they can be transformed to nitrate in soil and waters. Nitrate is also likely to remain in the water supply until consumed by plants or other organisms since they do not volatize. According to the U.S. Environmental Protection Agency (EPA), nationwide over 112 million pounds of nitrate and nitrite were released to water and land from 1991 through 1993. Notably, one of the largest releases of inorganic nitrates (from sources such as fertilizers) was in California.

Excessive N in the environment can have serious consequences, including altering ecosystems, eutrophication [an over-enrichment of water sources with nitrogen and phosphorus which causes accelerated growth of plant life (such as algal blooms) and which can disturb the balance of organisms and water quality], contributing to acid deposition and ozone depletion, and, as already noted, contamination of surface water and groundwater. According to the U.S. Department of Health and Human Services, N fertilizers have contributed to a 40-year trend of increased nitrate levels in surface water and groundwater of agricultural regions.

This increased level of nitrates in groundwater has some serious health implications if it enters into the water supply. The current safety guidelines for nitrate contamination of water were established in 1974 with the Safe Drinking Water Act. The maximum contaminant level (MCL) for nitrates was set to 10 ppm (1 ppm for nitrites), which is considered to be low enough to avoid any potential health problems. Although acute nitrate poisoning of humans is rare, at levels beyond 10 ppm, nitrate in drinking water can cause serious illness and even death. Infants are particularly susceptible to a disease of the blood supply in which the oxygen-carrying capacity of the blood is affected by conversion of nitrate to nitrite by the body. Long-term health issues (which result from a lifetime of exposure at levels beyond the current government standards) include diuresis (increased excretion of urine) and increased starchy deposits and hemorrhaging of the spleen.

Given the potential implications of nitrate contamination, turfgrass fertilization BMPs must take into account ways to minimize nitrate contamination of surface water and groundwater. Research has shown that nitrate contamination of surface water due to runoff is rare due to the relatively high infiltration capacity of turfgrass ecosystems (with the exception of severe slopes, which require careful irrigation cycling). The results of research on nitrate leaching, however, are more variable, with soil type, irrigation, N source and rate, and season of application all potentially affecting nitrate leaching.

The objectives of the research project are to 1) evaluate the annual N rate and source on tall fescue to determine which treatments optimize plant performance and N uptake while reducing the potential for nitrate (NO_3^-) leaching; 2) quantify the effect of N fertilizer rate and source on visual turfgrass quality and color, clipping yield, tissue N concentration, N uptake, and concentration of NO_3^--N at a depth below the rootzone; 3) develop BMPs for lawns under representative irrigation practices to optimize plant performance and N uptake while reducing the potential for NO_3^- leaching; and 4) conduct outreach activities, including oral presentations and trade journal publications, emphasizing the importance of the BMPs and how to carry out these practices for N fertilization of lawns.

The project is being conducted at two sites with different climates and turfgrass maturity, but which are being maintained similarly. One site is a newly established tall fescue plot (sodded late Sept. 2002) in northern California at UC Davis and the other is a mature tall fescue plot (seeded April 1996) in southern California at UC Riverside. Both sites were established to tall fescue, since it is the most widely used lawngrass in California, especially for urban landscapes. The plots at both sites are irrigated at [100% ET_{crop}/DU] minus rain, with the amount of irrigation determined weekly based on the previous 7 days' cumulative ET_o. There are two irrigation events per week, which are cycled to prevent runoff. The experimental design at both sites is a randomized complete block (RCB) design with N treatments arranged in a 4×3 factorial (four N sources and three rates). A no-nitrogen check treatment is also included to allow for additional statistical tests. The application of treatments and data collection will be coordinated between the two sites in order to allow for the most robust statistical analyses possible for comparing the results from the two sites.

Both quick release and slow release N sources are included in the study, both of which have distinct advantages and disadvantages relative to the other. Quick release N sources provide a rapid but short-term turfgrass response while slow release N sources provide a slow but long-term response. Quick release sources are generally less expensive and more efficient (in terms of the percentage of applied N recovered in grass clippings) than slow release N sources, but also have the greater tendency for foliar burn, volatilization and leaching. The specific N sources used in the study include: ammonium nitrate, a fast-release, water soluble N source; Polyon, a slow-release, polymer-coated N source; Milorganite, a slow-release, natural organic N source; and Nutralene, a slow-release, water insoluble, methylene ureas N source.

Each fertilizer will be applied at three annual N rates, including a low (4.0 lb N/1000 ft^2), moderate (6.0 lb N/1000 ft^2) and high (8.0 lb N/1000 ft^2) rate. The moderate rate of 6.0 lb N/1000 ft^2 has been found to be sufficient to provide acceptable visual turfgrass quality and color while maintaining a healthy, moderate growth rate. It is expected that the 4.0 lb N/1000 ft^2 rate will not provide acceptable visual turfgrass quality and color and that the 8.0 lb N/1000 ft^2 rate will result in excessive growth and potentially greater nitrate contamination than the other fertilizer rates.

In order to measure nitrate leaching below the rootzone, suction lysimeters were installed so the distal tip of the porous cup of each lysimeter was at a depth of 2.5 feet below the soil-thatch layer (approximately 0.6 inch deep). The lysimeters (constructed using high-flow ceramic cups and 2-inch diameter PVC pipe) were installed at a 45° angle so the lysimeter cup is below undisturbed soil. Twenty-four hours prior to each sampling day, a vacuum of approximately –40 KPa is applied to the lysimeters. Leachate is removed from the lysimeters using via vacuum, and samples are then acidified to pH 2, frozen, stored, and shipped via next-day air to the DANR Laboratory for NO_3^--N analysis by diffusion-conductivity analyzer.

Rounding out the "point-in-time" data from the lysimeters, measurements required to account for a hydrologic balance (including soil water content) and soil NO_3^--N measurements are being taken. The hydrologic balance is used to estimate the total NO_3^--N mass leached. Soil volumetric water content is determined weekly using time domain reflectometry (TDR) with four to eight sensors installed in null plots (plots within the research area which are not associated with any of the treatments). Soil NO_3^--N is determined at four rootzone depths: 0 to 12, 12 to 24, 24 to 36, and 36 to 48 inches below the soil-thatch layer (approximately 0.6 inches below the surface). Three cores are taken from each plot using a King Tube (i.d. 0.84-inch), cut and pooled by depth, dried at air temperature, sieved, and sent to the DANR Laboratory for NO_3^--N analysis by equilibrium extraction with KCl and diffusion-conductivity analyzer. Soil NO_3^--N provides a direct physical/chemical measurement of the movement (a layer) of NO_3^--N through the soil profile. It is useful for determining the accumulative effects over time.

Several additional measurements are being made throughout the course of the study. Visual turfgrass quality and color ratings are taken once every two weeks, in order to estimate plant performance and response to the N-fertility treatments. Also, clipping yield is taken weekly during four growth periods, with each period spanning four consecutive weeks and beginning one month following a N-fertility treatment application. The weekly clipping yields are dried and weighed to provide an estimate of plant growth for the previous 7 days. The four weekly yields within each growth period are then pooled by each plot and analyzed for total Kjeldahl nitrogen (TKN) analysis at the DANR Laboratory. With appropriate calculations, N uptake during the four 4-week growth periods is then determined. Finally, weather data is taken continuously from an on-site CIMIS station and a datalogger is installed at the research plot, which is recording soil temperatures at the 4-inch depth.

When completed, this project will add to our current understanding of NO_3^- leaching from turfgrass (tall fescue in particular). The resulting BMPs will include the best way to fertilize tall fescue (rate and source) for optimal plant performance and N uptake while reducing the potential for NO_3^- contamination of groundwater. The BMPs have the potential to have a wide impact since they will be directly relevant to California home-lawn owners.

INFLUENCE OF PLANTING PROCEDURES ON WOODY PLANT ESTABLISHMENT

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Improperly installed landscapes can lead to poor aesthetic quality. Other factors such as detrimental effects to the environment (fertilizer and pesticide runoff) can also occur. The environmental concerns may seem trivial now, but state regulations are underway to monitor and limit the loss of nutrients and pesticides from commercial landscapes. It is less costly to be proactive rather than reactive to these issues.

The health and aesthetic quality of woody landscape plants are influenced by four primary factors:

1) Site selection
2) Plant selection
3) Installation technique
4) Maintenance

Site Selection

Site selection is the first criterion to consider. Factors to consider include:

1) Drainage and aeration of the soil - Poor drainage is often one of the primary causes of poor plant performance of landscapes. Plant roots are unable to take up water and nutrients in poorly drained soils.

**Water Holding Capacity*

+*Sandy Soils* – Additions of organic matter will increase water holding and nutrient retention capacity of soils. This will improve water and fertilizer use efficiency of the plant material, and minimize runoff from the site.

+*Clay Soils* - Heavy clays need to be amended to increase aeration for the root systems.

2) Site exposure to the sun – Knowing the degree of sun exposure will partially dictate the type of plant material to use in the landscape. Plants such as azalea and camellia will perform poorly or die if exposed to full sun, especially for inland areas.

3) Proximity of the landscape to buildings, parking lots and public walkways – Landscapes located near large buildings must be planted with material that will not affect the structures through large branches or invasive roots. Likewise, certain trees, with invasive roots will eventually damage sidewalks and paved parking lots. Landscapes around paved areas also have limited space, so it is essential to consider plants of smaller dimensions that will not outgrow a smaller area.

Plant Selection

**Root System.* Select plants that are not root-bound in containers. If some root circling has occurred in containers, loosen roots to prevent continued circling once planted in the landscape.

**Root to Shoot Ratio.* Do not select plants with excessive shoot growth relative to roots. These plants will require frequent watering until an adequate root system can be established. Inspect trunks for any diseases or mechanical injury since damaged trunks will limit water and nutrient translocation to shoots and carbohydrate translocation to roots.

Installation Technique

**Planting Depth*. Proper planting depth is one of the most important factors that is often overlooked when installing landscapes. Planted to deeply, root systems will not receive adequate aeration and will die, leading to plant decline or death of the entire plant. One indication of plants installed too deep is the development of lenticels, small lesions or blisters along the stem. Planted too shallowly, excess drying of the rootball will occur due to wicking of water from the rootball to the air. Planting palms several feet below grade is unacceptable and will lead to tree death or very poor tree growth. Ericaceous crops such as azalea, camellia and many California natives are especially susceptible to decline due to deep planting. With these sensitive plants, root balls are planted level with the soil and then coarse mulch can be placed over the top to prevent drying of the rootball.

**Root Integrity.*

Balled and Burlapped plants - If the plant roots have been severed due to ball-and-burlap preparation or were pruned for some other reason, the shoots should also be pruned so that the demand for water and nutrients by the shoot canopy does not exceed to capabilities of the root system.

Containerized plants – Containerized plants should not be root bound, but should have sufficient root structure to prevent the root ball from falling apart.

Bare-root plants – Bare-root material, such as many deciduous plants should have a root structure that is intact and not excessively dry or wet. Large roots should be firm, with younger roots being firm but pliable. Roots that have been allowed to dry out excessively will often not recover. On the other hand, roots that are excessively wet and soft may be rotten. Most bare root plant material will have very few root hairs (thin, short roots). However, these will quickly grow back once the roots are planted.

**Shoot Pruning*

All plants, regardless of the way they were grown, should have a plant mass of roots to shoots that is relatively close to 1:1. The only exception to this rule is many palm trees, which can have a relatively small root mass relative the size of the shoot canopy. However, for most plants, if the root ball is smaller than the shoot canopy, some of the shoots should be pruned back so that the relatively small root ball can support the water needs of the canopy. Otherwise, post-installation techniques will require frequent watering until the root system is developed.

Post-Planting Maintenance

**Irrigation*

Irrigation programs for newly installed landscapes should be adjusted to meet the needs of plants with limited root systems. This means that frequent, but short episodes of irrigation should be scheduled until the root systems have been established. This will allow water to get to the root system. Excessively long and frequent watering will only result in wasted water and possible erosion, and runoff of pesticides and fertilizers.

**Fertilization*

Solid fertilizers - If granular fertilizers are used, the fertilizer should be placed relatively close to the root systems. Any fertilizer placed too far from the roots has a greater chance of dissolving and leaching away from the rootzones.

Liquid fertilizers – If fertilizer is being applied via liquid, care should be taken to irrigate near rootzones. Any liquid fertilizer being applied away from roots will likely leach or runoff from the site, increasing the risk of nutrient runoff.

**Staking and Tying*

Plants, such as standard trees with tall weak trunks, which are at risk for being blown down or excessively shaken in high wind, should be secured with support from stakes or wiring. This will prevent extreme trunk movement that can prevent roots from becoming established in the soil. However, care should be taken so that tight wires do not girdle the trunk. Also, stakes should not be inserted so close to the trunk in a manner, which damages the root system.

DRY-DOWN RESPONSE OF BERMUDAGRASS CULTIVARS

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A National Turfgrass Evaluation Program (NTEP, website: www.ntep.org) bermudagrass cultivar program was established at the UC Riverside Turfgrass Research Facility on June 30, 1997. Establishment and performance data were collected from the study until its conclusion on December 31, 2001. The research site was maintained with mowing, fertilization and irrigation until June 1, 2002, when all irrigation was shut off until irrigation was reinstated on August 15, 2002. The dry-down period was for 75 days. Turfgrass color was rated weekly during dry-down and also following the resumption of irrigation. The plot plan for the bermudagrass study follows.

Varieties 1-18 and 29 are seeded, 19-28 are vegetative

29	4	5	1	6	11	17	18
14	13	3	12	8	7	2	9
17	7	4	15	18	10	16	15
8	2	11	14	9	5	13	29
1	4	6	10	16	3	1	12
3	12	15	13	8	18	14	11
6	29	9	17	16	2	7	10
X	X	X	X	X	X	X	5
22	27	26	23	24	28	X	X
25	20	19	21	20	27	22	25
19	21	23	28	24	26	19	21
24	27	26	22	20	25	28	23

1 Savannah
2 2PST-R69C
3 Princess
4 SW 1-7
5 SW 1-11
6 Jackpot
7 Sundevil II
8 J-540
9 J-1224
10 Shangri La
11 Mirage
12 Pyramid
13 Majestic
14 OKS 95-1
15 Blue-Muda
16 Blackjack
17 Sahara
18 AZ Common
19 Mini-Verde
20 Shanghai
21 CN 2-9
22 OKC 18-4
23 OKC 19-9
24 Cardinal
25 Tift 94
26 Midlawn
27 Tifway
28 Tifgreen
29 Panama

LANDSCAPE WEED IDENTIFICATION AND CONTROL

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Landscape weeds can become an unsightly mess. In severe cases, they can crowd out desirable species and completely take over a planting. Years ago, we had little that we could do to combat these costly invaders other than hand removal or complete renovation of the site. We now have a better means of control. First off, we have better adapted ornamental species that are more competitive with weeds, numerous mulches to discourage weed germination and growth, and a few herbicides which can discourage weed germination or aid in recovery of weedy sites.

Why are weeds problems in the landscape? They fill voids where stresses from heavy use, improper management, disease, or insect attack have left openings for weeds to develop. The old adage that nature abhors a vacuum is certainly true in groundcovers and woody ornamentals where the "vacuum" is quickly filled with weeds. Even with the best varieties and management practices, openings for weed invasion may occur. This is where mulches, preemergent (PRE) and postemergent (POST) herbicides can help to temporarily eliminate weeds and aid in the reestablishment of a healthy, competitive ornamental cover.

Weeds

Annuals which often become problems in ornamental plantings include: annual bluegrass (*Poa annua*), crabgrass (*Digitaria* spp.*),* purslane (*Porulaca* oleracea), and spurge (*Euphorbia supina*).

Most annual weeds can be controlled with the proper use of a mulch or with preemergence herbicides. Organic mulches must be at least three inches in depth to be effective. Preemergence herbicide application must be properly timed prior to emergence of the weeds. In most areas of California, this would be in late February for crabgrass and in early September for annual bluegrass. Postemergence grass herbicides are available for the control of crabgrass in ornamentals, but annual bluegrass is only controlled by grass herbicides containing clethodim (check labels of all herbicides you are contemplating to use for compatibility with your ornamental species). Purslane and spurge emerge later than crabgrass and can also be controlled with the same preemergence herbicides.

Three of the most serious perennial weeds are bermudagrass (*Cynodon dactylon*), oxalis (*Oxalis corniculata*), and nutsedge (*Cyperus* spp.).

Common bermudagrass is commonly used as a warm-season turf, but it is also a difficult perennial weed in ornamentals in the warmer climates of the west. It spreads by seed and by stem sections (rhizomes and stolons). The rhizomes and stolons are many jointed and root at the nodes. Bermudagrass does not grow well in the shade preemergence herbicides will aid in the control of germinating bermudagrass seedlings. Repeated applications of postemergence grass control herbicides can reduce established bermudagrass.

Oxalis or creeping woodsorrel is a perennial that is often a serious problem in ornamental plantings. Oxalis grows year round producing running rootstocks and leaves similar to those of clover. There are no cultural controls available for this weed. Herbicides that control *Oxalis stricta* (an annual found in many southern states) do not control creeping woodsorrel. Preemergence treatment with herbicides containing pendimethalin, or isoxaben will limit emergence. Selective application of glyphosate as a spot treatment is helpful but care must be exercised to avoid the foliage of desirable plants.

Yellow (*Cyperus esculentus*) and purple nutsedge (*C. rotundus*) are serious perennial weeds in ornamentals. Yellow nutsedge is found extensively in California while purple nutsedge is limited to the warmest regions. Both produce an extensive system of underground tubers from which they can regenerate. Nutsedge is very difficult to control once it is established. When establishing ornamental plantings, plant in seedbeds that are free of nutsedge. Small, localized infestations of nutsedge can be reduced non-selectively with metham fumigation or repeated applications of glyphosate. Yellow nutsedge may be reduced in by multiple postemergence applications of glyphosate if care is exercised to avoid the foliage of desirable plants.

There are many more (over 200) weed species which can become problems in ornamental plantings in California. The first line of defense against these invaders is to maintain a healthy, competitive cover of landscape ornamentals. Mulching with landscape fabrics can be helpful particularly for controlling annuals and seedlings of perennial species. Fabric should be overlapped so that no light is allowed to penetrate to the soil. Use a polypropylene or polyester fabric or black polyethylene (plastic tarp) to block all plant growth. Fabric mulches can be covered with an organic mulch to improve esthetics. Organic mulches may also be effective by themselves if they are maintained at a depth of at least 3 inches and are managed in such a way as to not provide a growth media for new weed seedlings. Herbicides can be used to supplement good cultural practices when necessary.

NOTES: